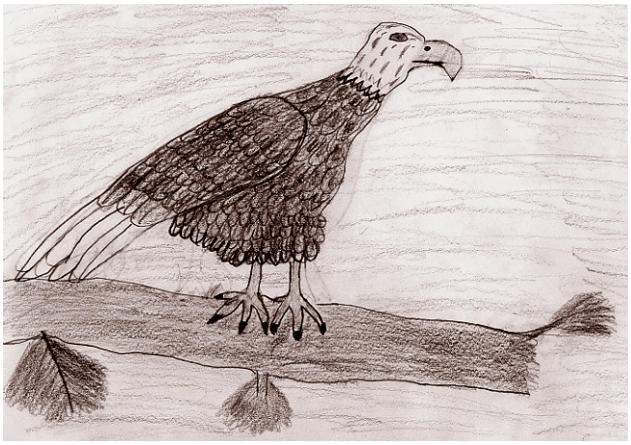
Animal Adaptations



CORTNEY YAZZIE

Outline

Theme
High desert animals are adapted to their environment in many different ways.

Utah State Science Core Curriculum
Topic: Utah Animal Life
Standard [3040-02]
Students will be able to:
- Develop and use a classification system for Utah animals.
- Relate animal structure to function.
- Explain how animal adaptations relate to acquisition of food, water and shelter.
- Suggest reasons for classifying living things.

Suggested Field Trip Locations
Several areas near Highway 128 northeast of Moab are excellent, including Big Bend Picnic Area, other areas along the Colorado River, and Negro Bill Canyon. Field trip needs include evidence of beaver and an area to explore that has several rodent burrows.

Background

An adaptation is a characteristic that makes an organism more suited to its environment. This program introduces students to both behavioral adaptations (activities) and physical adaptations (parts) of several high desert dwellers.

Students line up to test their "eagle eyes" at Big Bend.

Beavers, the largest North American rodents, are found along streams, ponds, and lakes throughout most of the United States and Canada. In southeastern Utah, habitat ranges from small creeks to large rivers to wetlands, in mountains and in desert canyons. Beavers are herbivores. They eat the cambium layer of bark, especially of willows, cottonwoods and aspens, as well as some green leafy vegetation. They are crepuscular, meaning that they forage most actively at dawn and dusk, when predation is less likely. They are rather clumsy on land, but they are excellent swimmers. When beavers dive, their heart and metabolic rates slow down, allowing them to stay underwater for up to 15 minutes. In wetlands and along small streams, beavers build stick-and-mud dams and lodges, often significantly altering the environment in the process. On larger, swifter streams such as the Colorado River, such construction is impossible. Instead they burrow out bank dens, holes several feet long and about 18 inches in diameter. The holes are underwater except when the river is low, but the dens slant uphill to dry living ledges. Beavers have numerous physical adaptations to this unusual lifestyle; these are addressed in the Amazing Beaver Adaptations station description.

Rodents are gnawing mammals with pairs of large, continually growing incisors in both their upper and lower jaws. Rodents also have grinding molars. Most rodents have four claws and no thumb on their front feet. Though this digit arrangement seems clumsy to humans, it may actually increase the speed and dexterity of rodents, enabling them to run faster, or gather and eat nuts faster. Most rodents spend much of their lives in burrows in the ground, thus avoiding temperature extremes as well as predation.

Mule deer have an array of adaptive characteristics that make them specifically suited to their environment. Their long necks and the location of their eyes on the sides of their heads allow them to see in every direction except directly behind them. The camouflage coloring of their coats is another defensive adaptation. Speed and agility are good examples of adaptive strategies as well. They can move up to twenty feet in one bound. A mule deer's large ears allow for a keen sense of hearing. The ears of a mule deer are roughly two-thirds the length of its head. A white-tailed deer's ears are one-half its head length. Hollow hair gives deer greater insulation from cold during winter. Mule deer have behavioral adaptations as well. Movement attracts prey; mule deer will freeze if danger is nearby. And if a predator is in pursuit, a mule deer's zigzag bound increases its likelihood of escape.

In Utah, an average of 80 percent of a mountain lion's diet consists of mule deer. Mountain lion physical adaptations for being successful predators include powerful jaws that can crush a prey's neck in one bite; sharp, pointed teeth; retractable claws for tearing meat; skin and fur between toe pads to muffle sound as the cats stalk; excellent day and night vision; and excellent depth perception so that they can attack with accuracy. Mountain lion behavioral adaptations include lying in wait and stalking, followed by bursts of speed for short chases.

An eagle's eyesight, like that of most raptors, is extraordinary. Most raptors can see ten times farther than humans. An object that humans can see at 33 feet is visible to an eagle at 330 feet. A raptor's eyes do not magnify so much as provide incredible distance perception. They are able to see movement and bright colors more easily than still, camouflaged prey.

PRE-TRIP ACTIVITY

Adapt and survive

Adapted from Caduto and Bruchac 1991, 170-172

PROCEDURE

1) Write *ADAPTS: Animals Depend on their Activities and Parts To Survive* on the board. Discuss what this means, explaining that animal activities, or behaviors, and body parts, are called adaptations. Have students think of several examples of animal activities and parts, and discuss how each helps its animal to survive.

2) Hand out an A card and a B card to each student.

3) Read the first section of the story "Coyote's Choice: Adapt and Survive." Have each student make the choice they think a coyote might make. Tell students to hold up their choice (A card or B card), all at the same time, when you say "Ready, set, go!" Read the correct survival choice.

4) Continue reading all the sections of the story in a similar manner. Have students keep track of whether they made the right choice or not for each section. Even if a student makes the wrong survival choice at a certain point in the story, have he or she continue making choices until reaching the end of the story.

5) Discuss student choices. How many were able to make the necessary choices to survive each time? Which choices made it most difficult to make the right survival decisions? Which choices were the easiest?

6) Review the items that students need to bring to school on the day of their field trip.

EVALUATION

Ask students to give at least two examples of coyote adaptations, and tell how these adaptations enable the animals to survive.

OBJECTIVES

Students will be able to:
- State two adaptations of coyotes.
- Tell how these adaptations enable coyotes to survive.

MATERIALS

- "Coyote's Choice: Adapt and Survive" (Caduto and Bruchac 1991, 170-172)
- An A card and a B card for each student (or have students print A on one half-sheet of paper and B on another)

TIME

- 30 minutes

PRE-TRIP

Objectives

Students will be able to:

- Name one physical adaptation (part) and one behavioral adaptation (activity) of lizards.
- Explain why catching lizards may harm the lizards.

Materials

- 30 strips of cloth (1"or 2" x 18")

Time

- 30 minutes

INTRODUCTORY ACTIVITY

Lizard's tails

PROCEDURE

1) In an open area without obstacles, instruct students to stand shoulder-to-shoulder in a circle. Ask any adults present to form a large circle ten or twenty feet behind the student circle. Ask if any students have chased lizards before, and if they have ever seen a lizard's tail fall off. Inform students that though lizards don't die immediately if their tails fall off, many of them may die later because their tails are where they store most of their extra fat, which they use during the winter. Explain that they are especially vulnerable if they lose their tails in the fall, but the tails take a long time to grow back, so they are vulnerable anytime. Lizards also have a hard time finding mates if they don't have a tail.

2) Inform students that they are going to become lizards, and pass out lizard tails (strips of cloth) to all of them. Ask them to hang their tails out of back pockets or waistbands, and to make sure that the tails are visible. Have students name a few lizard predators (besides humans). Ask them to turn around and face outward and close their eyes. Inform them that though most of them are lizards, you are going to tap two of them on the shoulder and these will become predators. The predators should remove the tail from their pocket quietly, and prepare to chase lizards and capture their tails. Ask all students to stay within the circle defined by adults, trying to stay away from the predators. Explain that if a predator captures a tail, that lizard is dead and must freeze. Other lizards may tag frozen students, but should then run away, because the frozen student then becomes a predator.

3) Give a start signal, and play until most of the students are predators. Ask students to return to the circle. Ask if any students are still lizards, and what they did to avoid being caught. Relate student strategies to lizard strategies. Relate these back to the concept of adaptations, and activity adaptations in particular. If you wish, discuss predator strategies as well.

4) Redistribute tails and play at least one more round. Afterwards, review adaptive strategies again.

NATIONAL PARK SERVICE

STATION ONE

Amazing beaver adaptations

Adapted from unpublished Aspen Center for Environmental Studies activity and other sources.

NOTE

Explore the area beforehand for beaver sign.

PROCEDURE

1) Show a picture or two of beavers, and find out what students know about them. Briefly discuss beaver diet and lifestyle, clarifying that beavers are herbivores, and are not fish-eaters. Explain that beavers on large rivers don't build dams and live in holes in the banks rather than lodges. Discuss the beaver signs that students may be able to find along the river, including fresh-cut trees with ridges left by beaver teeth; tracks and tail-drag marks; branch drag marks; slide marks entering the river; piles of cut branches and logs in shallow water; scat usually in shallow water; and holes in the riverbank if the river is low.

2) Explore the riverbank area for beaver sign. Examine beaver-cut branches and have students feel the ridges. Show pictures of tracks if you don't see any.

3) Discuss a few activities (behavioral adaptations) of beavers. Then choose a student volunteer to model a beaver's special parts (physical adaptations). Dress the student from the feet up with objects representing its various adaptations, explaining the adaptations as you go:

- Feet: Swim fins represent webbed hind feet for swimming.
- Feet: Rattail combs represent split claw (second claw of each foot) for grooming.
- Tail: A canoe paddle (attached by belt) represents the use of the tail as a rudder in swimming. Alternatively, a kickstand can represent the tail function of holding the beaver upright while it is gnawing on a tree. Beavers do not use their tails for patting mud (except in cartoons), but they do slap them on the water surface to make a loud noise that serves as a warning to other beavers.
- Fur: Use a pelt tucked under the belt to represent the beaver's coat. A beaver's coat consists of guard hair with a soft underfur. It provides insulation as well as a waterproof layer, thanks to the oil provided by an oil gland.
- Fat layer: Use a layer of foam tucked under the pelt to represent an insulating fat layer, to keep the beaver warm while swimming in cold water.
- Oil gland: Insert the WD-40 under the belt near the base of the tail. This represents the gland that produces oil for waterproofing the beaver's coat. Grooming with the split claw helps keep the coat oiled.
- Scent gland: Have students sniff the musk deodorant, then insert it under the belt near the WD-40. The scent gland produces a smell for marking territory and attracting mates.

OBJECTIVES

Students will be able to:

- Describe three physical adaptations of beavers.
- Describe the diet and one behavioral adaptation of beavers.

MATERIALS

- Beaver-cut stick if none in the area
- Pictures of beavers and beaver tracks
- Pair of small swim fins
- 2 combs
- Small can of WD-40
- Small can of musk deodorant
- Kickstand or canoe paddle blade attached to a belt
- Pair of "sticky-dot" work gloves
- Ear plugs or protectors
- Goggles
- Paper beaver teeth
- Beaver pelt or pile material
- Foam or ensolite (approx. 1' x 1.5')
- (optional) Beaver skull

TIME

- 30 minutes

STATION 1

- Hands: Put on "sticky-dot" work gloves to represent the rough pads for gripping on a beaver's front feet. These feet also have long claws for digging.
- Eyes: Swim goggles represent a nictitating membrane, or clear inner eyelid, that beavers can close while swimming to protect their eyes yet allow them to see. Beaver eyes are positioned near the top of their head, so they can see above water while most of their head is still underwater.
- Ears: Ear plugs or protectors represent special flaps inside beaver ears that close to keep out water while they are swimming.
- Mouth: Beavers have a flap at the back of their mouth that they can close to keep water out of their throat while swimming, even when they are carrying sticks in their mouth. If you have a beaver skull, show the gap between front incisors and back molars where sticks are carried. Finally, give the student model the paper front teeth, which represent the sharp front teeth of beavers, used for cutting trees and branches. These teeth grow continuously, and are made up of a hard brown enamel in front and a softer dentin behind. Chewing on trees gives their teeth a chisel-like edge.

4) To review, ask students to briefly describe each adaptation as you remove the objects, or have each student choose one object and describe the beaver adaptation it represents. Review beaver diet and activities.

STATION TWO

Investigating rodent burrows

PROCEDURE

1) Discuss the parts (physical adaptations) and activities (behavioral adaptations) that rodents in general have that help them to survive. Pass out a **Rodent Description Card** to each student. Have students take turns showing their pictures of rodents and reading the information about them aloud.

2) Prepare students to conduct a scientific investigation of rodent burrows. Ask them to work in pairs, and pass out a clipboard, pencil, ruler and back-to-back **Science Investigation Form** and **Rodent Burrow Data Sheet** to each pair. Explain that scientific method always follows the same basic steps, and that the first step is a question. Ask students to find and read the question that they will explore on the investigation form. Then have students look on the sheet to see that the next step in the scientific method is a hypothesis. Discuss, and have each student pair write a hypothesis on the sheet. Read and discuss the procedures printed on the form. Demonstrate how to measure the height and width of a burrow, to the nearest half-inch. Give examples of observations that students might record (e.g. The burrow has tracks in front of it, is near a gnawed cactus, or has a back door). Give students boundaries, and have them collect data from as many burrows for which there is time.

3) Gather students. Help them analyze their data by adding up the number of burrows in each half-inch increment of height to determine which burrow height is most common. Remember that you are looking for the most common size, not an average size. Explain the difference to the students if questions arise about this. Discuss whether the width of the most common height of burrow was fairly consistent, and if the results would have revealed the same burrow size as most common if you had looked for the most common burrow width. Have the students record the most common burrow height in the results section of their investigation forms. Discuss what rodent might be living in that size burrow, and why this rodent might thrive in this location. Have each student pair write a conclusion in the appropriate section of their investigation form.

OBJECTIVES

Students will be able to:
- Name two rodents and describe one adaptation of each.
- Follow the steps of the scientific process.

MATERIALS

- **Rodent Description Cards**, with pictures of corresponding rodents glued to backs of cards
- Back-to-back copies of **Science Investigation Form** and **Investigating Rodent Burrows Data Sheet**
- Pencils, clipboards and rulers

TIME

- 30 minutes

STATION 2

RODENT DESCRIPTION CARDS

Cut apart along lines and glue to 3" x 5" cards. Glue picture of rodent to back of each card.

White-Throated Woodrat (Packrat)
You can see my big dens, or middens, under rock ledges or in caves. I collect sticks, cactus spines, and anything else I can find to pile around my nest. I eat juniper branches and berries, and lots of other plants. I get my water from my food, so I don't have to drink. Owls, badgers, coyotes and snakes try to eat me. If I am scared, I may shake my tail against a dried plant to sound like a rattlesnake.

Prairie Dog
During the day, I look for grass and other plants to eat. I try to find it near my burrow. I live with other prairie dogs in colonies to help us in raising our young and watching out for predators. Eagles, badgers and rattlesnakes eat us. Early settlers named us prairie dogs because they thought our calls sounded like dogs barking.

Antelope Ground Squirrel
During the day I collect seeds and fruit to eat. I get all the water I need from my food. I eat cactus fruit, and can climb through the cactus spines without getting poked. When I get hot, I hold my white tail above my back for shade. Sometimes I go into my burrow and lay flat on the ground to cool off. I use burrows that other animals have left behind. Rattlesnakes, foxes, coyotes, golden eagles and hawks may eat me.

Beaver
I live near water. I eat bark and leaves, especially of willows and cottonwood trees. On creeks, I also build dams with the trees. These create ponds, which help more plants to grow. On big rivers, I make dens in the riverbanks and just eat the plants already growing there. I am built for swimming, and for chopping down trees.

Rock Squirrel
I live in rocky areas most of the time. But sometimes I live under sheds, in lumber piles or even in junk cars. I eat seeds, nuts, fruit, insects and dead animals. Sometimes I get into trouble trying to steal food from humans. I have to watch out for bobcats, badgers, coyotes, golden eagles and hawks.

Kangaroo Rat
I live in sandy areas, and am active at night. I use my paws to sift seeds and grains out of the sand. I don't have to drink, because I get all of my water from eating the seeds and grains. I hop like a kangaroo, and sometimes jump fifteen feet to escape a predator. My predators are owls, badgers, coyotes and snakes.

Deer Mouse
I can live almost anywhere, including human homes. Sometimes I dig my own burrow, but usually I find an abandoned burrow, a root hole, or a crack in a rock. I eat seeds, insects and sometimes leaves. I don't have to drink water, but I will if I find it. Owls, ringtails, snakes, foxes and coyotes will eat me.

Porcupine
I usually live near trees, and sleep in them during the day. At night, I collect and eat pine bark or plant leaves. Predators do not bother me because of the sharp quills that cover my body. The quills come off and stick into any animal that touches me.

SCIENCE INVESTIGATION FORM

Scientists' Names: _____ **Date:** _____

QUESTION

What size rodent burrow is most common here?

PREDICTION OR HYPOTHESIS

PROCEDURE

1. Find a burrow.
2. Measure and record height.
3. Measure and record width.
4. Make and record one or two observations about the burrow.
5. Repeat steps 1-4.
6. Analyze data.

RESULTS

What actually happened?

CONCLUSIONS

What did we learn or what do our results mean?

DATA SHEET

Investigating Rodent Burrows

BURROW #1

Height _____

Width_____

Observations

#1

#2

BURROW #2

Height _____

Width_____

Observations

#1

#2

BURROW #3

Height _____

Width_____

Observations

#1

#2

BURROW #4

Height _____

Width_____

Observations

#1

#2

BURROW #5

Height _____

Width_____

Observations

#1

#2

BURROW #6

Height _____

Width_____

Observations

#1

#2

STATION THREE

Deer's ears

PROCEDURE

1) Review the definitions of adaptation, predator, and prey. Show the pictures of a mule deer and a mountain lion, and discuss some of the adaptations of each.

2) Introduce the game (adapted from Henley 1989, 158-159). Designate one student as a deer, blindfold her, and put a cloth "tail" in her back pocket. Ask the deer to stand or kneel like a grazing deer, and not to move except to turn in one place. Ask the other students to pretend to be mountain lions, predators of deer. Instruct the mountain lions to start at least 20 feet away from the deer, and slowly stalk the deer. Cue them to begin stalking when you say "go," but instruct them to stop immediately when you say "freeze" (until they hear "go" again). Instruct the deer to listen for the predators approaching, and when she hears one, to point in its direction (within two to three degrees) and shout "Starve!" If the deer is correct, that predator must quietly sit down until the round is over. (To make the event more realistic, limit the number of times the deer can say "Starve!" to the number of predators plus five.) Tell the predators that if one of them gets close enough to the deer to snatch its cloth tail, then the deer is dead.

3) Let the predator that kills the deer be the next deer. (Another option is to simply take turns being deer.) Review deer and mountain lion adaptations between rounds or at the end.

EVALUATION

Have students create a dramatization of a mule deer, acting out the adaptations that help it survive in the wild.

Have students think up objects to represent deer or mountain lion parts, as in the beaver activity.

EXTENSIONS/VARIATIONS

To emphasize the adaptation of camouflage, play the Thicket Game (adapted from Project WILD 1992, 112-113). Choose a play area free of cryptobiotic soil, but with some rocks, trees or shrubs as cover. Blindfold a volunteer student predator in a designated central spot, and have the predator count to 15 while the other students, as prey, attempt to hide while keeping the predator in sight. Then have the predator remove the blindfold and look for the frozen prey, with the predator squatting or standing on tiptoes, but not moving from the designated spot. Tell the predator to identify any spotted prey; that prey must then come out of hiding. If the predator cannot find all of the prey, re-blindfold the predator, and have her count to 15 while the unfound prey move closer. At the end, ask for explanations of the prey's adaptive strategies, particularly that of the last prey caught.

OBJECTIVES

Students will be able to:

- State at least two physical and two behavioral adaptations of deer or their predators.
- Relate the adaptations to function and/or survival.

MATERIALS

- Pictures of a mule deer and a mountain lion
- Blindfold
- Cloth "tail"

TIME

- 30 minutes

STATION 3

Objectives

Students will be able to:
- Name at least two bird of prey adaptations.
- Describe how an eagle or other bird of prey's eyesight aids in survival.

Materials

- Laminated bird of prey pictures
- Small food items (M&Ms or Skittles)

Time

- 30 minutes

STATION FOUR

Eagle's eyes

Adapted from Henley 1989, 154-155

NOTE

If location and weather permits, hide M&Ms in advance for the second activity.

PROCEDURE

1) Build on prior student knowledge to talk about general raptor (bird of prey) characteristics and adaptations, and specific adaptations of various species. Distribute pictures as students name species of raptors, giving each student a raptor identity. Discuss raptor eyesight.

2) Activity #1: Eagle's Eyes. Ask each student to name one prey item that her raptor identity might look for, and hand out one M&M to represent that prey. Use a variety of M&M colors. Have students place the M&Ms together on the ground and then start backing away. When individual students can no longer see their M&Ms they have reached the limits of their eyes' resolving power, and should stop. Next, gather them where the first student stopped. Measure the distance from there to the M&Ms. Multiply that distance by ten, and you have the calculated distance from which an eagle could see an M&M. Discuss how high on the cliffs that distance is, which colors were easiest to see, and if a moving M&M (or mouse) would be easier to see.

3) Activity #2: I Spy with My Eagle Eyes. Have students pretend to be eagles or their chosen raptor and look for hidden M&Ms. When an M&M is seen, the raptor should say "I spy with my eagle (or other raptor) eyes something green (or other color)," without giving away the prey location. When most of the raptors have found most of the prey, start again or end the game. Review types of prey that raptors might look for, and their adaptations for hunting.

EVALUATION

Have students create a story or skit based on a raptor, including facts on eyesight adaptations.

Have students write a letter to the editor describing the adaptations and importance of birds of prey, and reasons for protecting them.

EXTENSIONS/VARIATIONS

Ask students to choose a raptor, research more of its adaptations, and write a story about how it uses its keen eyesight and other adaptations to survive.

Have students research the effects of DDT on bald eagles or peregrine falcons and other animals in the food chain. They may research what other toxins affect wildlife.

Have students research eagles (or raptors in general) and create mobiles with different types of adult and juvenile eagles (or raptors) that are found in the region.

STATION 4

POST-TRIP ACTIVITY

Win, lose or adapt

Adapted from National Park Service and others 1989, 8.12-8.18

PROCEDURE

1) With the students, generate a list of adaptations that humans have. Ask students to describe each adaptation and its usefulness to humans. Examples include: upright posture (seeing distances, holding and throwing objects, carrying things); eyes facing forward (judging distance); movable neck (seeing in many directions); ear lobes (gathering sound); big brains (intelligence); thumbs (precise and delicate hand movements); touch (sensitivity in hands and fingers); living in groups (cooperation, safety in numbers); speech (communication, cooperation).

2) Show the Animal Adaptations poster or write the names of animals represented in the game cards on the board. Instruct students in playing a game based on the adaptations of these animals. Divide the class into two teams. Have one person from the first team pick a **Draw the Adaptation Game Card** and take one minute drawing the adaptation named on the blackboard, while the rest of the first team guesses what it is. (Team two watches quietly; their turn may be coming soon!) If a guess includes part of the correct answer, write that part on the board. If team one does not guess the adaptation within a minute, give team two a minute to draw and guess from the same card. When correctly guessed, have a student read the card, which tells how the adaptation helps an animal to survive and names one animal with the adaptation. Continue the game, with the two teams alternating picking a card, drawing and guessing.

3) Integrate the activity with the field trip lessons by discussing the following types of questions:

- What are some of the adaptations we learned about on the field trip, and why are they important to these animals?
- Sometimes human activities actually make some animal adaptations harmful to animals. Examples include bird migration to countries that still use DDT, migration through areas that have lost habitat to development, and fish adaptations to warm muddy water on rivers that have been dammed and have clear, cold water now. Can students think of other examples? What are some animal adaptations that might be affected by human carelessness?
- What sort of adaptations might make animals likely to become extinct? (Specialized adaptations to small, isolated habitats or a specific food are risky.)

EVALUATION

Have students describe three problems that an animal learned about on the field trip would have if it were moved to the school grounds. Could these problems be solved? Why or why not?

OBJECTIVES

Students will be able to:
- Recognize that humans are animals with some unique adaptations.
- Identify two animal adaptations and describe how they help the animals to survive.

MATERIALS

- **Draw the Adaptation Game Cards**
- (optional) Animal Adaptations poster (labeled *Animal Adaptations*, with magazine photographs of the animals from the game cards glued to it)

TIME

- 30 minutes

POST-TRIP

DRAW THE ADAPTATION GAME CARDS

Photocopy and cut apart along dotted lines.

Adaptation:
Sharp-edged spade on each back foot

These help the animal burrow into the ground during dry times.

Spadefoot Toad

Adaptation:
Feet for grasping

Strong feet and large, curved claws, or talons, are used to kill and hold prey.

Hawk

Adaptation:
Paws with claws

Most meat-eaters use these to climb, dig for food, and hold their prey.

Fox

Adaptation:
Long, hollow beaks

These are used to reach nectar deep inside blossoms.

Hummingbird

DRAW THE ADAPTATION GAME CARDS

Photocopy and cut apart along dotted lines.

Adaptation:
Short, cone-shaped beaks

These are strong enough to open seeds.

Sparrow

Adaptation:
Hooked beaks

These are used to tear up animal food.

Hawk

Adaptation:
Forked tongues

These are used to "smell."

Snake

Adaptation:
Webbed feet

These help with swimming and with walking on top of mud.

Duck

DRAW THE ADAPTATION GAME CARDS

Photocopy and cut apart along dotted lines.

Adaptation:
Whiskers

These act as feelers when going through brush or small places.

Bobcat

Adaptation:
Long, pointed canine teeth

These are used to catch and kill prey.

Coyote

Adaptation:
Large hind legs

These help the animal jump long distances to escape predators.

Kangaroo Rat

Adaptation:
Stingers

These are used for protection.

Bee

DRAW THE ADAPTATION GAME CARDS

Photocopy and cut apart along dotted lines.

Adaptation:
Exoskeletons

These hard outer coverings provide protection from enemies, and keep the animal from drying out.

Insect

Adaptation:
Eyespots

These are used to scare away predators.

Butterfly

Adaptation:
Long tongues

These are used to zap food such as insects.

Lizard

Adaptation:
Horns

These are permanent and slow growing. They are used for defense and finding mates.

Desert Bighorn Sheep

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Cultural Contributions

WESLEY WILLIAMS

Outline

Theme
In order to learn important lessons from past peoples, we must preserve the artifacts they left behind.

Utah State Social Studies Core Curriculum
Topic: Cultural Contributions
Social Studies Standard [6040-02]: *Students will explain how the historical and cultural development of Utah is different from that of other states.*
Science Standard [3040-01]: *Students will analyze the diversity of plant and animal life in Utah.*

Suggested Field Trip Locations
A southeastern Utah rock art site in a transition community between desert shrub and piñon-juniper (that is, with at least several of the plants of Station #1). Two ideal locations are the petroglyph panel behind Wolfe Ranch near the Delicate Arch trailhead, Arches National Park, and Newspaper Rock Recreation Site on Highway 211, east of the Needles District of Canyonlands National Park.

Background

This program introduces students to the field of archaeology and its role in preserving our human past. Students learn how the ancient peoples of southeastern Utah used some of the plants of the area, and they experiment with making cordage, rock art, and pottery. Students learn how to enjoy archaeological sites without damaging them and are introduced to some of the threats to preserving past cultures, including vandalism of archaeological living sites and rock art.

Newspaper Rock petroglyphs

Some of the ancient peoples of the area grew corn, beans and squash, and the different cultures hunted animals to varying degrees. But all of the ancient peoples used wild plants of the area for food and other needs. The **Plant Use Clue Cards** introduce some plants and their uses.

Cordage consists of several strands of fiber twisted together into a string or rope. Prehistorically, cordage was made from a variety of materials including the long plant stalk fibers of milkweed and dogbane, yucca leaf fibers, and juniper and sagebrush bark. Ancient people also used human hair and animal sinew. Different sizes of cordage were made, probably depending on both plant fiber source and intended purpose of the finished object. Some archaeologists make replicas of cordage artifacts to learn more about how they were made and how much time was required to make them. A former Arches National Park ranger spent three months making a pair of cordage sandals similar to artifacts found in the area. Most cordage artifacts have been found in dry cave sites in the western U.S. Many are small pieces, but a net measuring 140 feet by 4 feet was found at Hogup Cave in northwestern Utah (Smith and others 1992, 133).

Archaeologists Winston Hurst and Joe Pachak (1989, 1) state that "in modern America, the most common kind of 'rock' art is that which is painted on the concrete and brick walls of the artificial canyons of our cities and on bridge abutments and rock faces along our highways. In modern American culture, as in all cultures, it expresses the values, attitudes, beliefs, and desires of the society." Others believe art in modern society often reflects the fringe or cutting edge of society, whereas ancient rock art usually represents more central societal values and beliefs. Because of this, some archaeologists now prefer the term rock images to rock art.

Though rock images occur around the world, there are few places where it is as common or varied as in southern Utah. Though it is possible to identify some of the images, such as a bighorn sheep or a sandal print, the context or symbolic nature is more difficult to determine. Many clues can be gained by talking to modern tribal members, though this method also confirms that one image may have different meanings in different contexts and cultures.

Because of the durability of fired clay pottery, potsherds are one of the most common types of artifacts. Pottery styles are distinctive to particular cultures and changed through time, so pottery is helpful in determining both age of a site and which group of people lived there. Pottery artifacts also give insights into how ancient people cooked and stored food and seeds.

The 1979 Archaeological Resources Protection Act prohibits disturbance of any archaeological sites more than 100 years old, on any federal lands. The act sets penalties for those convicted of violations. A first offender may be fined up to $250,000 and spend up to two years in jail. A second offender may be fined $250,000 and spend five years in jail. State lands are protected by a similar 1990 state law. The state law allows digging on private land with permission of a landowner before digging. Digging on private land without permission may bring penalties similar to the others. Disturbing a human burial is a felony offense.

PRE-TRIP ACTIVITY

Pieces of the past

PROCEDURE

1) Write *Archaeology* on the board and discuss its meaning. A simple definition is the study of people from the past. Inform students that when exploring the lives of ancient people who didn't have a written language, archaeologists must look for "pieces of the past," the objects that the people left behind. The objects are called "artifacts." Set classroom garbage can on a tarp (Smith and others 1992, 34-35). Ask the following types of questions as you use the tongs to explore the contents of the can: How might the garbage here be different from the garbage in a classroom in China? Your town 100 years ago? What can you learn about our behavior from the trash? Would the cafeteria garbage tell other things about our lives? What about your home garbage? Compare looking at archaeological artifacts to looking at ancient peoples' garbage. Put away can.

2) Ask students to think of an object that reminds them of their past, such as a baby blanket or a toy (Smith and others 1992, 9-10). Have a few students describe their objects. Ask if a stranger could learn something about their lives by examining the objects. Could he learn more by examining several objects from each student's past? Relate the objects to archaeological artifacts, and introduce the importance of saving these. Explain that on the field trip students will be exploring pieces of the past from the ancient people who lived in this area.

3) Describe the four field trip stations as follows: Have a student hide a shoestring in one hand, stand in front of the class, and reveal one fact about the mystery object. Instruct the other students to take turns, each asking one yes-no question about the object and taking one guess at its identity, until someone correctly names the object. Explain that students will be learning how the ancient people of this area made cordage (twine or string) and how they used it. Students will have a chance to make some cordage themselves. For the food station, show a sample local food plant and describe what things early people used it for. For the rock art station, have two students present the Petroglyph and Pictograph posters, and discuss. For the pottery station, have a student present the Pottery poster, and discuss. Give guidelines for enjoying archaeological sites without damaging or disturbing them. Review items that students need to bring on the field trip.

EXTENSION

Show *Sherdy: The Storyteller* video (Southern Utah University 1993), and discuss.

OBJECTIVES

Students will be able to:

- Name at least one reason why it is important to leave artifacts where they are found.
- Describe ways of enjoying archaeological sites without disturbing them.

MATERIALS

- Classroom garbage can
- Tarp
- Tongs
- Shoestring
- Piñon pine cone and piñon nuts, or other local food plant product
- Poster labeled *Petroglyphs* with drawings or photographs of southeastern Utah petroglyphs
- Poster labeled *Pictographs* with drawings or photographs of southeastern Utah pictographs
- Poster labeled *Pottery*, with photographs of a variety of Southwestern Native Peoples' pots and pottery designs

TIME

- 30 minutes

PRE-TRIP

OBJECTIVES

Students will be able to:

- Identify at least two plants and describe how ancient people used them.

MATERIALS

- **Plant Use Clue Cards** (3 sets on 3 colors of paper)
- Plant samples or living examples of approximately six of the following plants: four-wing saltbush, dock, rabbitbrush, juniper, barberry, Indian ricegrass, wild onion, piñon pine, Mormon tea
- A few food items from some of the plants such as piñon nuts and blue corn tortillas
- Grocery store basket or bag to hold food items
- **Owls and Crows Review Statements**

TIME

- 30 minutes

STATION ONE

Mmm, I'm hungry

NOTE

Choose approximately six plants living in the field trip area from the Plant Use Clue Cards. Hang name tags on living examples of the plants or place labeled plant samples near the initial meeting area, before students arrive. Remember, it is illegal to collect plant samples in national parks.

PROCEDURE

1) Ask students to imagine themselves as ancient people living here. Discuss some basic survival needs (food, water, and shelter) of both wildlife and people. Tell students that in this activity they will be focusing on a very popular aspect of survival, *food*. Ask students to look around them; what they see is what the ancient people in this area ate. Even more than hunting game (e.g., deer, bighorn sheep, rabbits), ancient people relied on harvesting plants for their survival. (Optional: Briefly go over plant parts, and ask students to think of foods that we eat today that come from specific parts of plants. Remind students that ancient people also ate and used different parts of plants).

2) Go over the chosen **Plant Use Clue Cards** with the whole group. Divide the group into three teams and give each team a different-colored set of the clue cards. Have teams try to match each card with the appropriate labeled plant, and place the card face down next to that plant. Encourage students; some of these are difficult.

NATIONAL PARK SERVICE/TOM GRAY

3) Back together as a group, go over the clues and their matching plants. Have students try some of the foods from the plants as they are reviewed (e.g., piñon pine nuts, blue corn tortillas).

4) To review, play Owls and Crows (Cornell 1979, 72). Have two teams, the owls and the crows, face each other. Read a statement from the **Owls and Crows Review Statements** list. Instruct students that if the statement is true, the owls chase the crows. If it is false, the crows chase the owls. Repeat any statements that are incorrectly answered sometime before the game ends.

PLANT USE CLUE CARDS

Copy three sets on three colors of paper. Cut into strips. Use one set of plant names to label plates. Discard other plant names. An extra copy may be used as an instructor answer sheet.

The ashes of my plant can be stirred into bread dough to make the bread turn greenish blue.

Four-Wing Saltbush

The young leaves of my plant can be gathered in early spring and cooked.

Dock

The stems of my plant make good baskets. I can make you sneeze in late summer and fall when my yellow flowers bloom.

Rabbitbrush

My blue berries can be used to flavor meat. My berries can also be dried and ground to form cakes.

Juniper

My berries are blue and they make good jelly.

Barberry

Ancient Indians used my grains for food.

Indian Ricegrass

My bulb was used in seasoning foods.

Wild Onion

The nuts from my cones were pounded and made into cakes or cooked like a cereal.

Piñon Pine

Tea made from boiling my stems may cure your cough or cold.

Mormon Tea

OWLS AND CROWS REVIEW STATEMENTS

Practice Statements

Plants produce oxygen ..... T

Ancient people shopped at grocery stores ..... F

Review Statements

(Skip statements relating to plants not covered during station.)

People need food to survive ..... T

Piñon trees produce nuts ..... T

Ancient people gathered food at City Market ..... F

Ancient people ate all the plants around here ..... F

Rabbitbrush is a small purple plant ..... F

Ancient people drank Mormon tea ..... T

Four-wing saltbush ashes make bread dough blue-green ..... T

Wild Onion is not used for seasonings ..... F

Ancient people used plants to make baskets ..... T

Piñon pine nut soup was given to babies ..... T

Ancient people lived here a long time ago ..... T

Indian ricegrass was used for shelter ..... F

STATION TWO

Making cordage

From Smith and others 1992, 132-135

PROCEDURE

1) Ask students where they purchased their shoes and how long they think it took to make them. Show students the cordage replica and/or pictures, and discuss how long these took to make. Discuss with students how making their own shoes in this way would change their lives.

2) Distribute a piece of twine to each student. Have students examine the twine and see if they can determine how it was made. Define fiber as a slender, threadlike strand or string. Describe cordage, on the other hand, as consisting of several strands of fiber twisted together into a string or rope. Students may use twine for their first attempts at making cordage and advance to natural plant fibers as they are ready. Explain and demonstrate the steps to make cordage: If using natural fibers, remove debris by rubbing the plant fiber between the palms of your hands. Next, whether using twine or plants, separate two long strands. Hold one end of Strand A and one end of Strand B together, side-by-side, in your left hand between forefinger and thumb (vice-versa if left-handed). Pick up Strand A between right forefinger and thumb, and twirl the strand away from your body (clockwise). Take the twisted Strand A, and bring it toward your body, over and then under Strand B. Hold Strands A and B between your left forefinger and thumb about where you crossed A over B. Repeat the twirling and crossing sequence: Pick up Strand B, twirl it away from your body, and cross it over and under Strand A. Continue these steps.

3) After all the students have been successful in making cordage, discuss their impressions of daily life of prehistoric people. In what ways might it have been similar to their daily life? In what ways was it different?

EVALUATION

Evaluate students' cordage to check skill mastery.

Allow students to make cordage and use it in some way that ancient and/or modern people might have.

OBJECTIVES

Students will be able to:
- State one way prehistoric people used cordage in everyday life.
- Perform the skill of making cordage.

MATERIALS

- Twine, cut into 12 to 15 inch lengths
- Cordage replica such as yucca sandals and/or picture of cordage artifacts
- 12 to 15 inch lengths of natural materials for making cordage, including milkweed or dogbane stalks; yucca leaves, sagebrush bark and/or juniper bark

TIME

- 30 minutes

STATION 2

Objectives

Students will be able to:
- Describe the difference between petroglyphs and pictographs.
- Name one reason for preserving rock art panels.

Materials

- Petroglyphs and Pictographs posters (See Pre-Trip Activity)
- Scratchboards (available from Salix Corporation, (801)531-8600), or paper, pencils and clipboards

Time

- 30 minutes

STATION THREE

Symbols on rock

Adapted from Smith and others 1992, 151-153

PROCEDURE

1) Gather students around the rock art panel. Give students guidelines for observing the rock art without touching, and time to observe the panel and talk with each other about the symbols. Discuss some possible meanings of the symbols.

2) Have students imagine that they are living in this area one thousand years ago. Ask students if they would live here permanently. Is there enough water nearby? What would they use for shelter? How would they hunt? What would they hunt? Ask students to think about why they might create rock art if they lived here.

3) Using the panel, petroglyph and pictograph posters, and your own drawings, show students examples of international symbols and rock art symbols. Explain that we don't know what the prehistoric symbols mean, though a few seem obvious and we can get some pretty good ideas about some of them by speaking with modern tribes or studying archaeology. Explain to students that they will be using symbols to create some of their own "rock art." With the students, brainstorm examples of symbols they would recognize. Give students time to think of symbols that mean something to them in their own lives. Give each student scratchboard or paper, pencil, and clipboard to sketch her own symbols. If using scratchboards, instruct students in their use.

4) As students finish up their rock art creations, discuss how they would feel if someone came along and threw rocks at their rock art, wrote their name on it, or defaced it in any other way. Relate their feelings to how archaeologists, Native Americans and others feel when they see a site that has been vandalized. Explain that it is against a law, the Archaeological Resources Protection Act, to deface ancient rock art.

EVALUATION

Evaluate students' rock art through brief individual discussions of the interpretation of the symbols they used and the relevance of these to their lives.

STATION 3

STATION FOUR

Pottery

PROCEDURE

1) Use Pottery poster to focus student attention. Ask students to point to the pottery piece from which they would like to drink hot chocolate, which they would want if they needed to carry water, which they might set into the coals to cook stew, etc. Remind students that the ancient people who made the pottery on the poster didn't have plastic or metal pots and pans. Mention how styles change today from one year to the next, and explain that the ancient people changed pottery styles through time, as well as people in different areas having different styles. For these reasons, and because pottery lasts a long time, pottery and potsherds provide good clues for archaeologists about ancient people.

2) Have students imagine that they are archaeologists, and that they have been investigating this area. Pass out an artifact or picture of an artifact to each student. Ask students to examine their artifact, then hold them out so that they can see all of them. Discuss briefly or compare with poster. If using real artifacts, explain that they were collected by an archaeologist and the careful mapping techniques that an archaeologist uses.

3) Discuss the process for making pottery. Include all of the main steps: finding and collecting the clay, forming the pottery, and firing the pottery. Have students pretend to jump into a time capsule and become ancestral Puebloan (Anasazi) Indians. Tell them that they need to make some pottery. Explain that wheels for throwing clay haven't been invented yet, so they will use a coil method.

4) Demonstrate how to make coil pottery and how to brandish the coils using fingers or smooth stones. Instruct students to make miniature pots and figures, as ancestral Puebloan and Fremont children commonly did. Distribute clay. Have students sit on the tarp to work, and help the students in making their pottery.

5) Have students show their pots and describe different ways they might use them if they lived in this area one thousand years ago.

OBJECTIVES

Students will be able to:
- Explain at least one reason why artifacts are important.
- Make a coil pot or figure.

MATERIALS

- Artifacts borrowed from a museum, or pictures of artifacts
- Pottery poster (See Pre-Trip Activity)
- Clay
- Tarp

TIME

- 30 minutes

STATION 4

Objectives

Students will be able to:

- Define chronology or describe what a time line represents.
- State at least two reasons that artifacts shouldn't be removed from archaeological sites.

Materials

- Index cards or paper squares (four per student plus a few extras)

Time

- 40 minutes

POST-TRIP

POST-TRIP ACTIVITY

All mixed up

Adapted from Smith and others 1992, 22-23

PROCEDURE

1) Review the definition of archaeology and the role of an archaeologist. Introduce the concept of a timeline or chronology. Draw on the board and discuss a cross-section of two or three soil layers containing artifacts, including modern "artifacts" in the top layer. Draw a historical linear timeline and/or a timeline of your own or someone else's life as another way to illustrate chronology. Show the importance of sequence by switching two events or removing an event, and seeing the resulting confusion. Explain that chronological data is important in understanding how past peoples lived, and that digging up archeological sites destroys this chronology.

2) Pass out four index cards to each student and instruct students to write an important event in their lives on each card (e.g., "My sister was born," "My family moved," "I learned to ski," "I got my dog, Max"). Have students arrange their cards in chronological order, most recent on top, in the same arrangement as artifacts in layers at archaeological sites.

3) Have each student mix up her set of cards and exchange sets with a partner. Instruct students to make a best guess at the order of their partners' tags. Partners should check the cards and explain any mistakes in the chronology. Then have each student randomly remove one card from his own set and exchange cards with a different partner. After ordering and checking, ask if partners had a more difficult time guessing the chronology with one event missing. Explain that digging through an archaeological site is like mixing up the cards and taking artifacts is like removing events. Briefly describe the careful digging and recording of an archaeological dig.

4) Discuss the following questions: Imagine that you cannot remember significant events in your life. How would that change the history of your life? How does digging in an archaeological site cause the loss of information about the past? In what ways is a hole dug by vandals in the archaeological site similar to a loss of significant events in your life? What might you say to an artifact collector about the importance of leaving sites undisturbed?

EVALUATION

Ask students to complete a timeline of significant events in their lives and describe its importance to them. Then have them relate the importance to an archaeological site.

Have students create informative posters on why people shouldn't alter archaeological sites.

Ask students to write a story of what they might do upon finding an amazing archaeological site.

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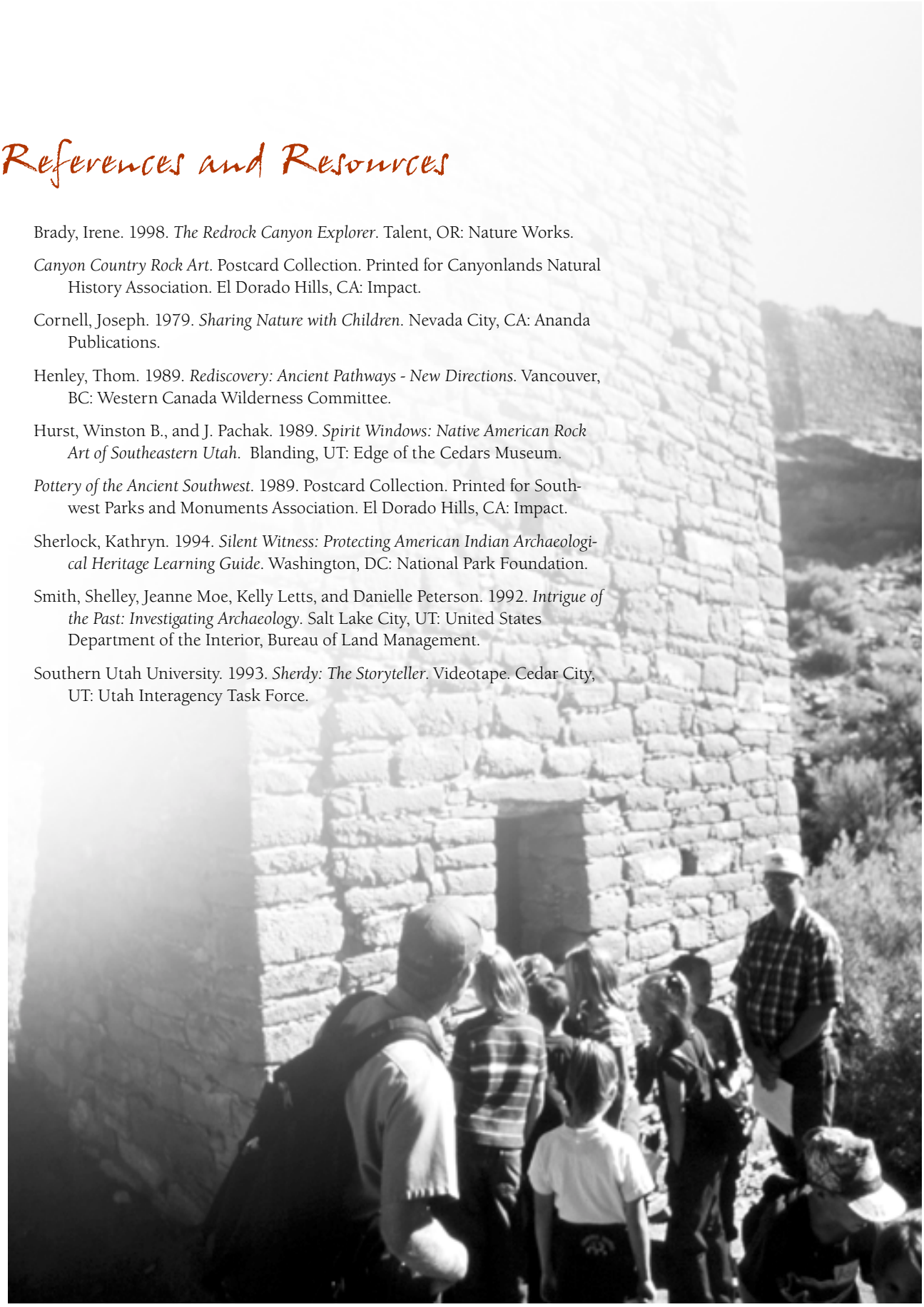
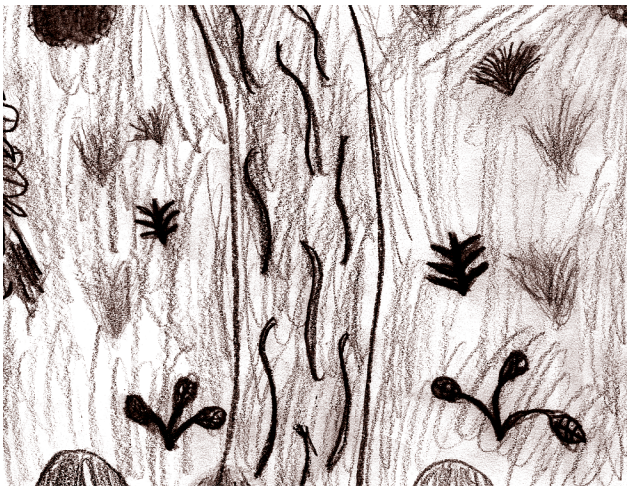


Water Cycle



CARIE GARLETT

Outline

Theme
Water is essential for all life.

Utah State Science Core Curriculum
Topic: Water Cycle
Standard [3040-03]
Students will be able to:
- Explain the water cycle.
- Explain the processes of melting, precipitation, evaporation, condensation, percolation, and erosion.
- Construct a chart or drawing of the water cycle.

Suggested Field Trip Locations
The Nature Conservancy Scott M. Matheson Wetlands Preserve, Moab. Other locations are suitable for many of the activities. Any season except winter; students may get a little wet.

Background

Key words in the water cycle concept are *evaporation*, *transpiration*, *condensation*, *precipitation*, *surface runoff*, and *percolation*. Of these, *transpiration*, *condensation* and *percolation* are the words least familiar to fourth graders. *Transpiration* is the escape of moisture from plant leaves, similar to *perspiration* in humans and other animals. A helpful metaphor for explaining cloud *condensation* is a glass of ice water. Because air cools near the glass, and cool air can't hold as much moisture as warm air, some moisture condenses onto the side of the glass. *Percolation* refers to the concept of water filtering down into the ground through porous soils.

The Nature Conservancy's Matheson Wetlands Preserve, the only major wetland along the Colorado River in Utah, is an ideal location for this program.

Most wetlands are transitional lands that lie between terrestrial systems (such as the Moab Valley) and aquatic systems (such as the Colorado River). The key ingredient in a wetland is water. Some wetlands always have standing water; others appear to be dry much of the year. But all are at least seasonally flooded with shallow water, or the soils are at least seasonally saturated. All wetlands have specialized aquatic plants at least part of the year, specialized undrained soils, and the presence of water. The particular types and arrangements of these three characteristics are what make one kind of wetland distinct from another. Marshes, swamps, potholes, bogs, fens, floodplain wetlands and sloughs are all names that reflect the diversity of types of wetlands. Some of these are informal names, including sloughs, a name historically used for the Matheson Wetlands, that has also been used for a variety of other types of wetlands.

Water comes into wetlands from two main sources: surface water and ground water. Surface water is runoff over the land. In the case of the Matheson Wetlands, Mill Creek, irrigation runoff, and the Colorado River are the main sources of surface water. Surface water follows gravity to the wetlands. That is, water from Mill Creek and its tributaries runs downhill from the La Sal Mountains, across the Moab Valley, and then slows down in the relatively flat wetlands before continuing on the slight downhill grade to the Colorado River. The river contributes surface water to the wetlands only during springs when the river is high enough (near 40,000 cfs) to overflow its usual banks into the wetlands. The Colorado River flooded the Matheson Wetlands three out of every ten years prior to 1959; since then, the frequency of flooding has decreased (due to dams, irrigation, etc.). Much of the water in the Matheson Wetlands comes from ground water. Some springs and seeps where underground water comes to the surface emerge at the base of the slopes across highway 191 from the north end of the wetlands. Ground water also seeps to the surface within the wetlands themselves, from saturated underground rock layers and sediments near the surface.

Wetlands contribute to the quantity and quality of our water supply. Dry lands soak up some rain and briefly recharge or replenish ground water after a rainfall. Because wetlands collect runoff and store standing water over longer periods of time, they slowly release water to the ground-water supply. Wetlands and wetland plants are traps for both sediments and pollutants that are washed off the land. Because water traveling at high velocities has the ability to pick up and carry much sediment, water coming off of steep slopes is usually sediment-rich. When that water slows down, such as it does in the relatively flat lands found at the base of slopes where wetlands are commonly located, it drops its sediments. Plants contribute to slowing down the waters, and act as sediment traps; they also filter nutrients from water and use them in their own metabolism. Wetlands keep pollutants (including excess nutrients), which are attached to sediment particles and in the water, from degrading the quality of surface and ground water.

PRE-TRIP ACTIVITY

Poetic water cycling

PROCEDURE

1) Explain that students will be visiting the Matheson Wetlands on their upcoming field trip. Show, orient and discuss aerial photograph of the wetlands, if available.

2) Introduce the water cycle, using **The Water Cycle** poster and/or a story. Include the vocabulary of *evaporation*, *precipitation*, *runoff*, *percolation* and *ground water*.

3) Review some of the important aspects of water, including that all plants and animals need water to live. Tell students where tap water comes from in their area. Explain that water is also important to the human spirit. Give examples, such as camping near a river or mountain stream, going on a river trip, listening to the sound of rain, or experiencing a rainstorm or snowstorm. Ask two or three students to describe one reason they appreciate water, or an experience with water that was memorable. Ask other students to hold onto their ideas. Explain that, after you read them a story, they will be writing a unique kind of poem based on some of their own experiences or feelings. Set the stage for the story: Southern Arizona, in the Sonoran Desert, is even hotter than Moab in the summer, and it usually doesn't rain one drop for a couple of months in early summer. But in late summer, the rains start. Read *It Rained on the Desert Today* (Buchanan 1994). Discuss the story briefly.

4) Instruct students to write a poem called a *diamonte*, about their own experiences with water in nature. The "water experience" could be a rainstorm, blizzard, or an experience along a lake, stream or ocean. Hand out blank paper, and ask students to take out pencils. Write the description of a diamonte on the blackboard, as you explain it.

DIAMONTE

Line 1: 1 word (noun) that is the main subject of your experience.

Line 2: 2 adjectives describing it.

Line 3: 3 things it was doing (verbs or actions).

Line 4: 2 feelings about it.

Line 5: 1 word it reminds you of.

5) Encourage volunteers to read their poems and discuss their experiences. Inform students that the field trip will focus on the water cycle in the wetlands. Review the items that students need to bring on the field trip.

OBJECTIVES

Students will be able to:

- Describe the basic components of the water cycle.
- Express a personal experience in the structure of a diamonte.

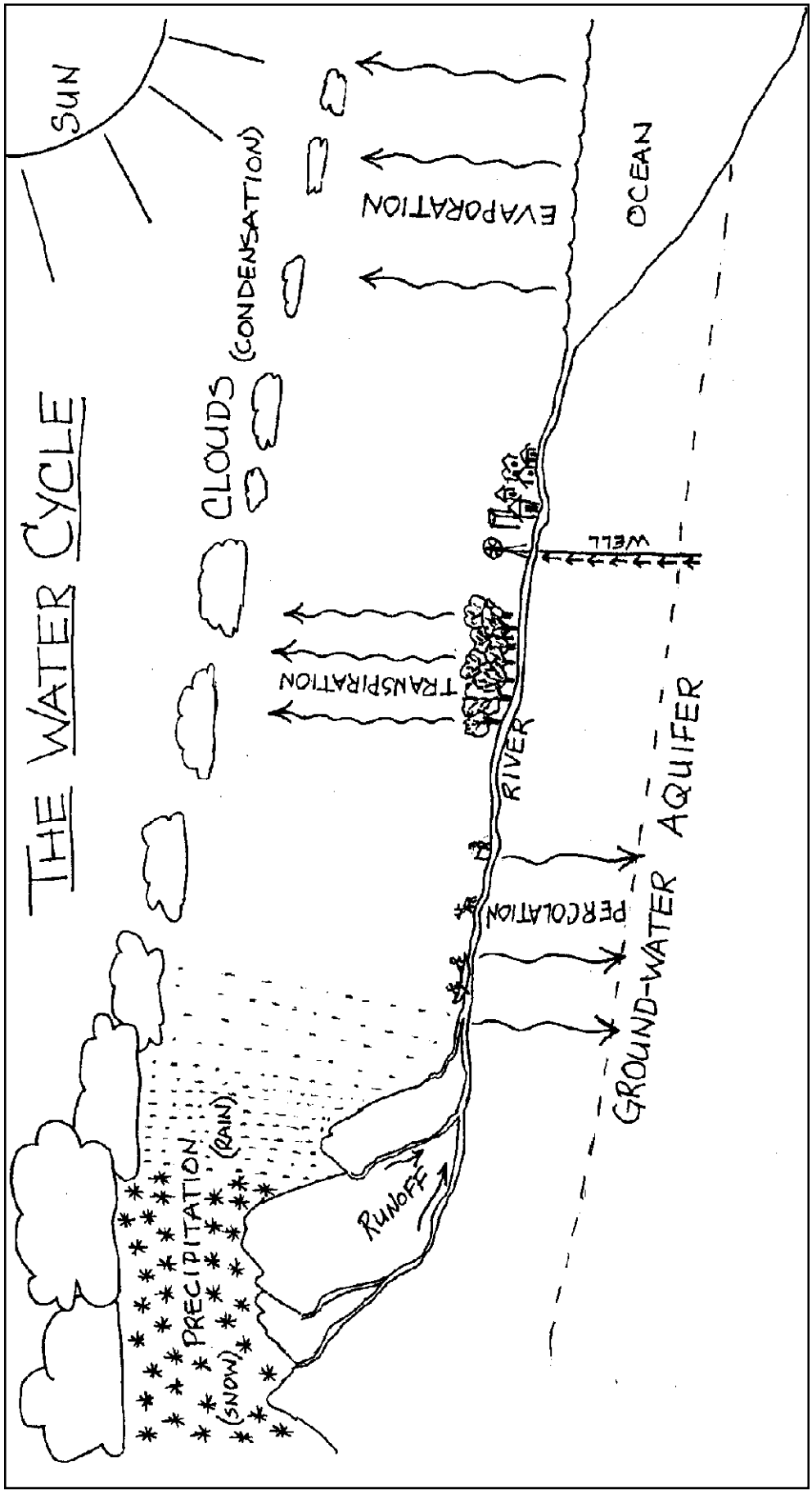
MATERIALS

- **The Water Cycle** enlarged to poster size
- *It Rained on the Desert Today* (Buchanan 1994)
- Half-sheets of paper
- (optional) Story about the water cycle
- (optional) Aerial photograph of Matheson Wetlands Preserve.

TIME

- 30 minutes

PRE-TRIP


THE WATER CYCLE
SUN
CLOUDS
(CONDENSATION)
EVAPORATION
OCEAN
WELL
TRANSPIRATION
RIVER
AQUIFER
PERCOLATION
GROUND-WATER
PRECIPITATION
(RAIN)
(SNOW)
RUNOFF

STATION ONE

Erosion motion

Objectives

Students will be able to:
- Compare rates at which water flows through different areas.
- Name two benefits of water slowing down in the wetlands.

Materials

- 2 buckets
- 20 beanbags
- 4 name tags, each labeled PLANT
- Stopwatch
- (optional) "The Hero Twins and the Swallower of Clouds" (Caduto and Bruchac 1988, 78-81)

Time

- 30 minutes

PROCEDURE

1) Briefly discuss why clouds, rain and water are important to this region. (Optional: Read the story "The Hero Twins and the Swallower of Clouds.")

2) Have students look around the area surrounding them and imagine what it would be like in a thunderstorm. Remind them that water always flows downhill, quickly on steep ground, and more slowly on less steep ground. Around here it flows to the Colorado River, and then downstream to the ocean. Point out the bare and steep slickrock, where the rain runs quickly downhill and is not stopped by anything. Next point out or have them visualize washes, which are often less steep than the slickrock slopes. The less steep slopes slow the water, as do the plants at the edges of the wash. Finally, point out the wetlands, where there are so many plants and there is such a low slope, that the water almost stops. Tell the students that as water runs it picks up soil and nutrients and carries them with it. It carries the most sediments and nutrients when it is moving fast; as it slows down the sediments and nutrients drop out of the water. Discuss the benefits of having water slow down in the wetlands. Slow-moving water a) keeps the wetlands soils from washing away; b) adds sediments to the area; c) adds nutrients, which combine with the sediments to form rich wetlands soils that nourish the plants; and d) collects in pools for wildlife to drink.

3) For the first round of the erosion activity, ask students to act out water from a rainstorm, which takes soil and nutrients from the top of the cliff to the river. Place two buckets 100 feet apart on the walkway, with the closest one full of beanbags. Have students line up at the beanbag bucket. As water, have each student carry soil and nutrients (a beanbag) down the slickrock slope (path) to the river (far bucket). Once they deposit their soil and nutrients in the river, have students run back to the beginning to get another load of nutrients. Instruct students to stay on the designated path. To avoid collisions, have those running to the river bucket stay on one side of the path, and those returning to the beanbags stay on the other, as they will all be running simultaneously. Time how long it takes for the group to move all the soil and nutrients to the river.

4) In the second round, water runs down a wash instead of traveling across slickrock. Give one or two students plant name tags to wear, and place them along the edges of the path between the buckets, to represent plants along the edge of the wash. Instruct the plant-students that they are rooted and cannot move their feet, but should try to capture nutrients from the water running by using their branches (arms). Any water-student that gets tagged must run around the plant twice (simulating soaking into the soil), and drop a nutrient bag at the plant's feet. Then the tagged student can run back to the start and get another beanbag. Time how long it takes for the group to empty the soil/nutrient bucket. Compare the times of round one and round two, relating it to

the slower movement of water down a plant-edged wash compared to movement down steep slickrock. Discuss how much sediment and nutrient the plants captured.

5) For the third and final round, water runs through a wetland. Designate two or three students as plants, and line them up in the middle of the path. Play and time as before. Discuss with the students how long it took the water to flow through the wetlands versus down washes or slickrock. Discuss how much sediment and nutrient the plants captured.

6) Review the results of the activity. Which places did water flow fastest and slowest? Where did it soak in the most, and deposit the most sediments and nutrients? Why?

EVALUATION

Have students think of other areas in which rain falls. Ask them to write a story describing the movement of water through one of these areas.

STATION TWO

Do the water-cycle twist

Adapted from Caduto and Bruchac 1988, 90-91

PROCEDURE

1) Discuss and review the water cycle, its components (*evaporation*, *condensation*, *precipitation*, *transpiration*), examples, and the sources of water for the wetlands. Tell students to prepare to act out the water cycle in a relay. Place buckets in pairs, 35 to 40 feet apart, with the lake sign by the closer pair and the cloud sign by the other. Form two teams, and have them line up in two parallel lines behind the lake buckets. If you wish, have them name their teams for two wetland animals, and use that as a lead-in to talk briefly about a few of the wetland animals in the area.

2) Use guided imagery: "Imagine these (closer) buckets of water are big, blue lakes and you like to ____ in them." (Students fill in the blanks.) "As the sun heats up the lake, some water evaporates and rises up, cools off, and condenses to form white fluffy ____. Imagine that you are now evaporators with the power of the sun. When it is your turn, use the cup, scoop up water from the lake bucket, and run up to the clouds." Explain that it is important to conserve water; the object is to pour as much as possible of the water into the cloud bucket, while traveling as quickly as possible. After pouring, each student should run back and hand the cup to the next person in line. Start relay. As students run, comment on what a hot day it must be with all this evaporation occurring, or describe the clouds getting heavier and darker. When one of the team's buckets is empty, call stop. The winning team is the one with the fuller end bucket (not always the team who emptied their bucket first). Commend students on conservation strategies they came up with (hand over cup, cooperatively tipping bucket for easier scooping when water got low, etc.).

3) Have students stand with you in a circle, and tell them that they are going to work together to create a thunderstorm. They are to mimic whatever the person to the right is doing, and make no other sounds. Start the storm off by rubbing your hands together (wait until everyone is doing this around the circle one by one), then click your fingers, then clap your hands on your knees, and finally stomp your feet. Reverse the order of the movements as the storm recedes. Ask the students if they recognized the sounds of a thunderstorm. Discuss runoff and percolation.

4) Have students line up in teams at the cloud buckets for another relay. Adjust the water volume in the buckets according to how much time you have left, and equalize them. Inform students that they are now precipitators, and will take water from the cloud to the lake. Have them each choose a type of precipitation to be. Start relay, and interject comments as in the first relay.

OBJECTIVES

Students will be able to:
- Identify the four main parts of the water cycle.
- Describe the processes of evaporation and condensation.

MATERIALS

- The Water Cycle poster (See Pre-Trip Activity)
- Two full buckets of water and two empty buckets
- Two sturdy cups
- Lake and cloud signs
- Extra water if not available at site.

TIME

- 30 minutes

STATION 2

Objectives

Students will be able to:

- Observe, measure and record several parameters of water flow.
- Relate at least one observation or measurement to a weather factor or human-induced factor.

Materials

- Copies of **How's the Water?** data sheet
- Clipboards
- Pencils
- Meter sticks
- Thermometers.

Time

- 30 minutes

STATION THREE

How's the water?

PROCEDURE

1) Review the water cycle. Tell students that they will be exploring runoff along a stream at this station. Explain that they will work in pairs, and investigate how water color, smell, depth, speed and temperature differ from one place to another along a nearby stretch of the stream. Ask for predictions or hypotheses. Divide students into pairs, and distribute a **How's the Water?** sheet, clipboard and pencil to each pair. Read over the steps of the inquiry, pausing to have each pair write down at least one prediction. Demonstrate how to make different types of measurements asked for on the sheet.

2) Define the area along the stream in which each pair will be taking measurements. Choose areas as diverse as possible. But keep the areas relatively close to each other for monitoring student activities, unless you have extra adults that can go with each pair. Monitor and assist students as needed as they collect data.

3) When students are finished ask each pair to present their findings at their data collection location. Discuss the results, and have students write one or two important differences between the areas.

4) Explain that conclusions are things learned from the investigation. Discuss and have students write conclusions. Discuss weather and human activities that can affect some of the water qualities measured. Discuss where the stream originates, and upstream factors that might alter it.

EXTENSION

Repeat measurements in a quiet-water area of the wetlands. Compare results.

STATION 3

DATA SHEET

How's the water?

Students' Names: _____ Date _____

QUESTION

How deep, fast, smelly, colorful and cold is the water in different places along a stretch of the stream?

PREDICTIONS OR HYPOTHESES

_____

_____

PROCEDURE

Each student pair chooses a different location along the stream. Then each collects data to answer the following questions:

1. How deep is the water at the edge, 10 cm from the land?

2. How deep is the water 1 meter away from the edge?

3. How deep is the water in the middle of the stream?

4. What color is the water? Use descriptive words or comparisons.

5. Can you see the bottom? _____ If so, describe what you see on the bottom.

6. Does the water have a smell? _____ If so, what does it smell like?

7. Stick your hand in the water. Does it feel warm, cold or very cold?

8. What is the temperature of the water?

9. What is the temperature on the land surface, away from the stream?

10. Is the water flowing slowly or quickly? _____ Is the speed different in the middle of the stream than along the edge? _____ If so, how?

RESULTS

What were the main differences between the areas?

CONCLUSIONS

What did you learn?

Objectives

Students will be able to:
- Name three characteristics of wetland soil.
- Describe two effects of wetland soil on water and pollution.

Materials

- Trowel
- Observation tray
- Nine pie pans
- Nine milk jugs with tops cut off and holes in the bottoms
- Sand, gravel and wetland soil
- Water
- Cups
- Food coloring
- Clipboards
- Paper and pencils

Time

- 30 minutes

STATION FOUR

Pollution solution

Adapted from Slattery 1991, 122; and Anderson and others 1998, 9

NOTE

Before the activity, set up three sets of three milk jugs sitting in pie pans. Fill one jug in each set with gravel, one with sand, and the other with wetland soil. Also put some wetland soil in an observation tray, and collect a jug of muddy water from the creek. Stir up the creek if necessary; the water must be muddy for this experiment to work persuasively.

PROCEDURE

1) Show students the tray of wetland soil. Ask students to explore the soil using all their senses. Note the dampness, color, scent, texture, smell, and different grain sizes. Ask students to compare the soil to soil they have seen in their backyards or in Arches. Discuss the formation of soil in the wetlands, and the plants (and thus animals) that benefit from this rich, organic soil.

2) Divide students into three small groups. Each group will experiment with a set of three milk jugs/pie pans, and will need a cup for pouring, a sheet of paper, a pencil and a clipboard. Ask students to fold the paper lengthwise, for predictions on one side and results on the other. Have them divide the paper into thirds in the other direction, for the three substrates in the different milk jugs. Label the three: gravel, sand, and wetland soil. Ask the students to write down two predictions for each substrate: how fast the water will travel through the substrate, and whether the water will be clear, slightly muddy, or very muddy when it exits. After they have written predictions for all three, have them pour an equal amount of water through each, observing and writing down the results for each on their sheet. When they are finished, discuss the results, including which soils acted as better filters, and the beneficial effects of this filtering.

3) Ask students what might have happened if the water we poured through the jugs was polluted. With their input, list a few pollutants that might be in the water entering the wetlands. Ask where they think the pollution would go if the wetlands were not here. If there's time, simulate the filtering of invisible pollutants by pouring colored water through a jug of wetlands soil, and discuss. Have students clean off their pie tins.

EXTENSION

In small groups, have students create soil that they think would both filter and hold water as well as wetland soil does. Have each student in a group bring an element (i.e., dead plants, sand, mud) to mix together. Compare a jug test on the mixture to the wetland soil jug test. Discuss results and what they could add or take out to make the soil more like wetland soil.

POST-TRIP ACTIVITY

The water cycle journey

PROCEDURE

1) Review with students the four field trip stations. Write the water cycle components on the board as they are mentioned.

2) Show the poster. Discuss the named features and their roles in the local water cycle. Instruct students to each make a map on their own similar to the poster, and then add the parts of the water cycle. On the blackboard, model how to integrate one of the water cycle components. Ask students to draw, and then label both the local physical features and the parts of the water cycle. Add to the blackboard list so that it includes all features and components that they are to label.

3) Circulate among the students as they work on their drawings. Many of them may need help getting started or completing their drawing. Ask volunteer students to share their drawings with the class.

EVALUATION

Have students create another water cycle drawing, this time of an imaginary land. Have them make up names for landforms, and label the landforms as well as the water cycle components.

OBJECTIVES

Students will be able to:
- Reproduce a drawing of their local area, and label local features;
- Integrate major components of the water cycle into their drawing.

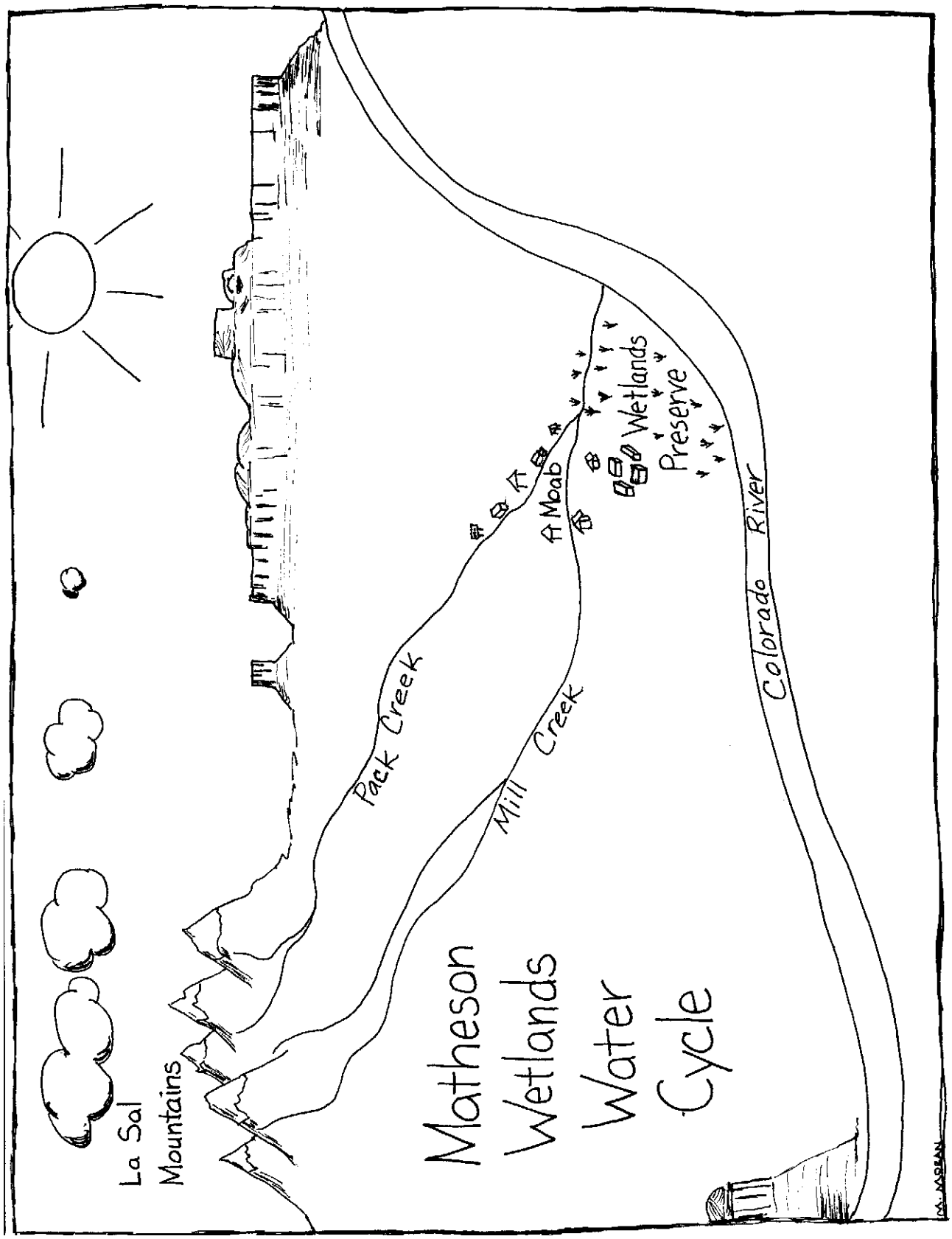
MATERIALS

- **Matheson Wetlands Water Cycle**, enlarged to poster size (adapted to field trip area as needed)
- Unlined paper

TIME

- 30 minutes

POST-TRIP


La Sal
Mountains
Pack Creek
Mill Creek
Moab
Wetlands
Preserve
Colorado River
Matheson
Wetlands
Water
Cycle

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